U. S. FOREST SERVICE

RESEARCH NOTE NC-6

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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Growth Response of Seedling Yellow Birch to Humus-Mineral Soil Mixtures

Previous observers of the establishment of yellow birch have cited the importance of mixed humus-mineral soil seedbeds.[1,2] Godman and Krefting pointed out that both germination and growth were enhanced.[1] Subsequent studies[3] have shown that while germination in the absence of competition is adequate on mineral soil of a Podzol A_2 under a wide variety of light and moisture conditions, growth is uniformly poor. On humus, good growth was obtained but adequate germination occurred only in part of the environments tested. This Note reports the growth response of yellow birch seedlings grown on various mixtures of mineral soil and humus.

Procedure

Humus and mineral soil were collected from the same profile of a well podzolized soil underneath a hemlock-hardwood stand near Marquette, Mich., and six volumetric mixtures were made up: (1) humus, (2) ¼ A_2, ¾ humus, (3) ½ humus, ½ A_2, (4) ¾ A_2, ¼ humus, (5) A_2, and (6) A_2 with a cold water extract of the humus added periodically. Seed stored from a single tree collection made in 1962 were scattered on pots of the various mixtures.

The pots were arranged in five blocks in randomized block style on a greenhouse bench under a bank of fluorescent and incandescent lights with a daylength of 16 hours. After germination, all but five of the tallest seedlings were removed from each pot. Pots were watered from below.

Seedlings were measured every 2 weeks. After 80 days, plants were removed and roots were washed, dried, and weighed. Leaves and stems were weighed separately. Root-shoot ratios were calculated from dry weights.

One block germinated poorly; this was discarded from the experiment. Significance was tested with standard analysis of variance and regression techniques.

Results

Both height growth and dry weight increased as the amount of humus in the mixture increased (fig. 1). Treatment differences are significant at the 1-percent level. The addition of the humus extract (data not shown in fig. 1) appeared to depress growth slightly but not significantly in comparison to the 100-percent mineral soil treatment.

Dry weight increment of all major plant parts was decreased by the addition of mineral soil to humus but leaves responded most (fig. 2). On a percentage basis (fig. 3) the distribution of dry matter was relatively unchanged in stems; root weight increased and leaf weight decreased as mineral soil content increased. This disproportionate change in dry matter resulted in an increasing root-shoot ratio as the mineral soil content of the mixture increased:

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1 *Godman, Richard M., and Laurits W. Krefting. Factors important to yellow birch establishment in Upper Michigan. Ecology 41: 18-28, illus. 1960.*

2 *Jarvis, J. Cutting and seedbed preparation to regenerate yellow birch in Haliburton County, Ontario. Can. Dep. Northern Affairs and Natur. Resources, Forest Res. Div. Tech. Note 53, 17 pp., illus. 1957.*

3 *Data on file at the Northern Hardwoods Laboratory, North Central Forest Experiment Station, Marquette, Mich.*

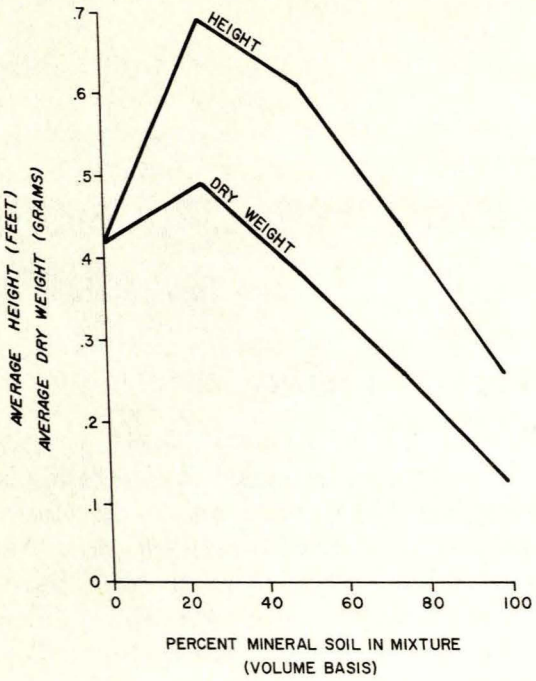

Figure 1.—Average height and dry weight of seedlings grown in varying mixtures of humus and mineral soil.

Percent mineral soil	*Root/leaf ratio*[1]	*Root/stem ratio*[2]	*Root/shoot ratio*[3]
100	.62	1.03	.40
75	.60	1.03	.37
50	.39	.65	.23
25	.27	.52	.17
0	.27	.47	.17

1 Root-leaf ratios were computed from leaf and root weights.

2 Root-stem ratios were computed from stem and root weights (leaves were not included).

3 Root-shoot ratios were computed from stem plus leaf weights and root weights.

Discussion

In the environment in which the plants were grown, mineral soil additions to the humus depressed growth generally but root growth decreased less than did that of leaves, thus increasing root-shoot ratios. In the field, survival should be enhanced as a result of the more favorable moisture relations usually ascribed to better balance between absorbing and transpiring organs. However, good height growth is necessary to keep yellow birch above other species competing for light.

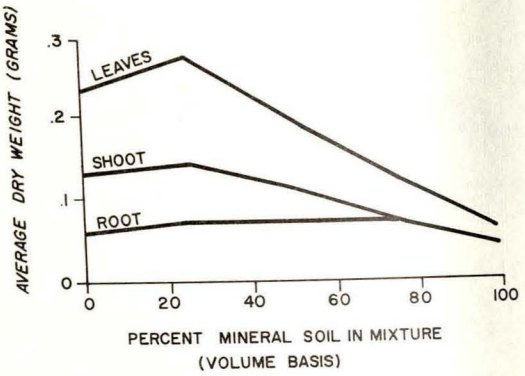

Figure 2.—Distribution of average dry weight of seedlings by plant part of seedlings grown in varying mixtures of humus and mineral soil.

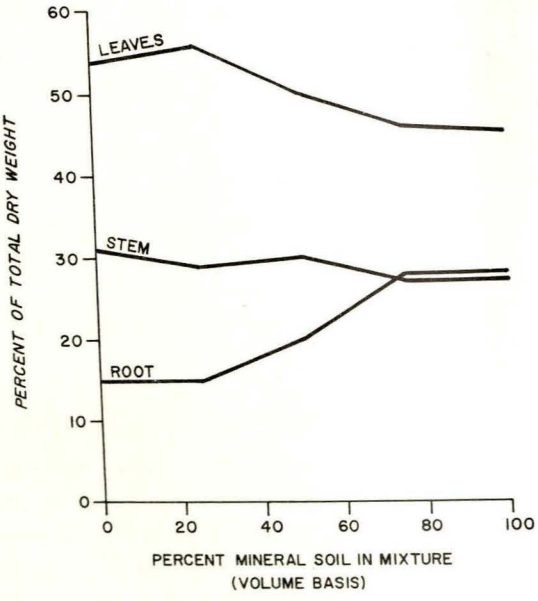

Figure 3.—Percentage of total dry weight by plant part of seedlings grown in varying mixtures of humus and mineral soil.

A 50-50 mixture seems to be the best compromise since height growth does not increase greatly with humus proportions of more than 50 percent and root-shoot ratios are still relatively good.

CARL H. TUBBS
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